October 2002 Volume XXXIV, Number 5

Tsunami Newsletter

INTERNATIONAL TSUNAMI INFORMATION CENTER - ITIC

SUMMARY OF EARTHQUAKES IN THE PACIFIC

Occurring August-September 2002

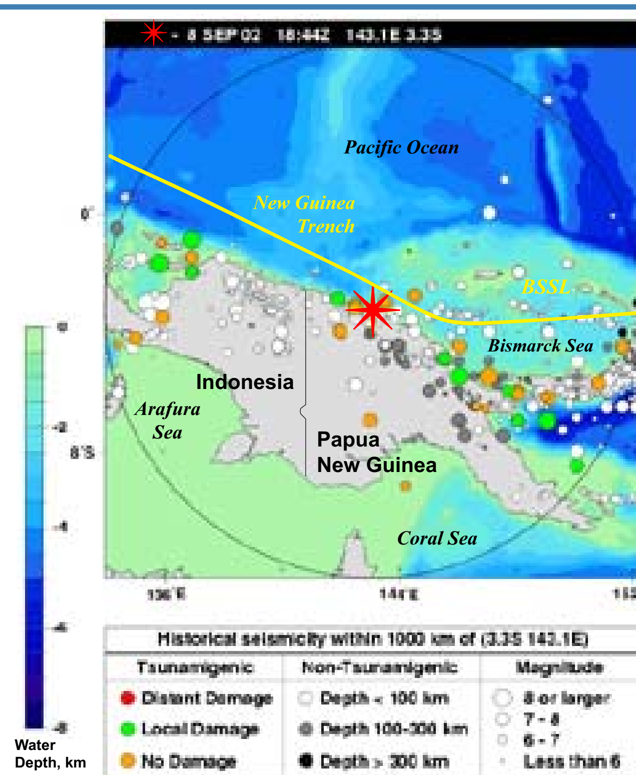
With surface wave (M_S) or moment magnitude (M_w) greater than or equal to 6.5 and a depth no greater than 100 km, or an event for which a Tsunami Information Bulletin (TIB) or Regional Watch Warning (RWW) was issued. Epicenter and M_w from USGS/NEIC (G); preliminary M_S from PTWC (P) at time of action; and depth from Harvard (H).

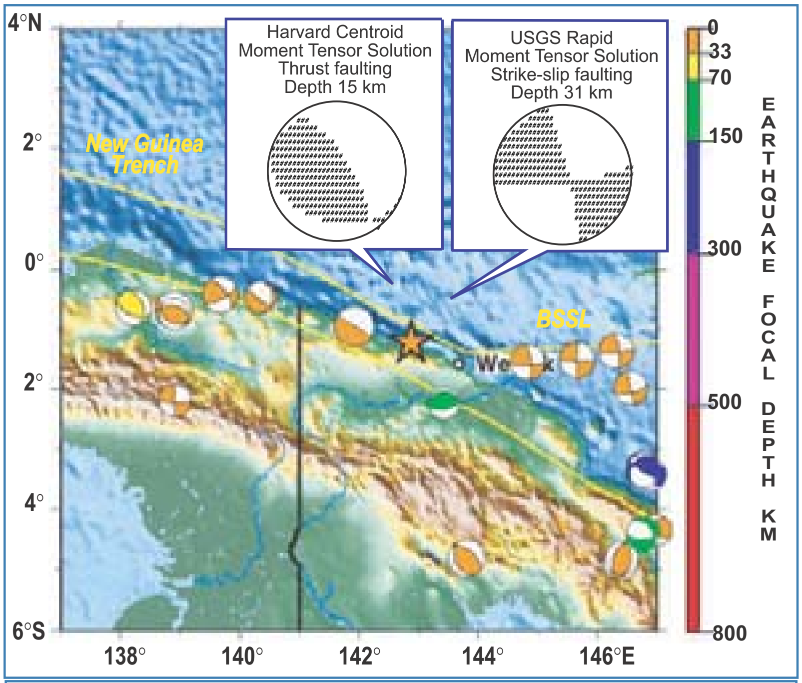
DATE	LOCATION	TIME (UTC)	LAT.	LONG.	DEPTH (km)	M_S	M_W	PTWC ACTION	ACTION (UTC)	Tsunami ?
Sept 8	Near North Coast of Papua New Guinea	18:44	3.228 S	142.870 E	15	7.4 (P) 7.6 (P) 7.7 (P)	7.3 (G)	TIB#1 RWW#2 RWW#3 RWW#4 RWW#5	19:08 19:27 20:27 21:27 21:53	YES

8 September 2002 18:44 UTC Papua New Guinea

The epicenter of the 8 September 2002 event (0444 local time, 9 September) was located near the eastern intersection of the New Guinea Trench with the Bismarck Sea Seismic Lineament (BSSL) where the Pacific, Australian, and Bismarck plates meet, and offshore about 60 miles (95 km) west-northwest of Wewak, New Guinea, Papua New Guinea. Seismicity over the last ten years shows this area to be characterized by shallow (less than 33 km) earthquake activity along the strikes of the New Guinea Trench and BSSL.

Considerable damage was caused by the earthquake, especially in areas underlain by unconsolidated sediment. At least five people were killed and several villages damaged in East Sepik Province. A local tsunami was observed about 15 minutes after the earthquake in Wewak. Run up was generally less than 1 m, but reached up to 3-4 m in west-facing bays on adjacent islands and the mainland coast immediately east of Boiken. The tsunami caused little or no damage to property, and no injuries nor deaths resulted from the tsunami. Professor Hugh Davies of the University of Papua New Guinea led a post-earthquake and tsunami reconnaissance team to survey the damage; his report is included in this issue of the Tsunami Newsletter.

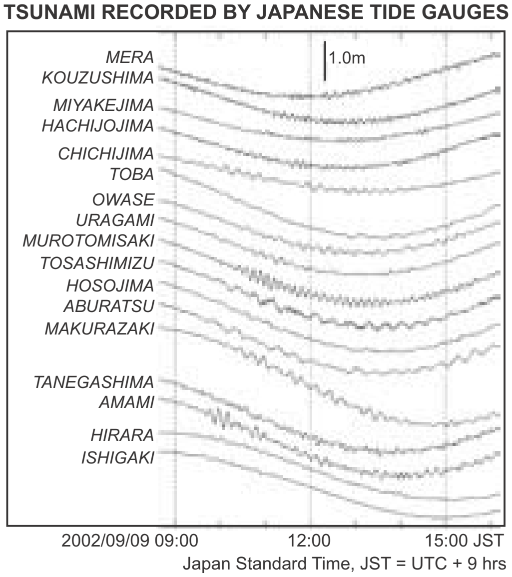


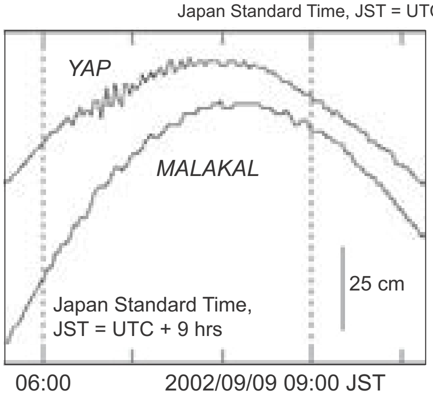


Historical Moment Tensor Solutions (USGS National Earthquake Information Center). Plate Boundaries shown in yellow. Harvard Centroid and USGS Rapid Moment Tensor solutions suggest faulting associated with the subduction at the New Guinea Trench or sliding along the Bismarck Sea Seismic Lineament (BSSL)

8 September 2002 18:44 UTC Papua New Guinea-Tide gauge records

TSUNAMI RECORDED BY JAPANESE TIDE GAUGES





Tide data from JMA

station	Lat.	Long.	maximum wave amplitudes (cm) *
MERA	34˚55'N	139˚50'E	8
KOUZUSHIMA	34˚12'N	139˚08'E	8
MIYAKEJIMA	34˚03'N	139˚33'E	6
HACHIJOJIMA	33˚06'N	139˚46'E	10
CHICHIJIMA	27˚05'N	142˚11'E	8
TOBA	34˚29'N	136˚50'E	4
OWASE	34˚04'N	136˚13'E	8
URAGAMI	33˚33'N	135˚54'E	8
MUROTOMISAKI	33˚16'N	134˚10'E	15
TOSASHIMIZU	32˚47'N	132˚58'E	6
HOSOJIMA	32˚26'N	131˚40'E	4
ABURATSU	31˚34'N	131˚25'E	10
MAKURAZAKI	31˚16'N	130˚18'E	12
TANEGASHIMA	30˚41'N	131˚04'E	9
AMAMI	28˚19'N	129˚32'E	20
HIRARA	24˚48'N	125˚17'E	4
ISHIGAKI	24˚20'N	124˚09'E	2
YAP	9.51˚N	138.13˚E	
MALAKAL	7.33˚N	134.46˚E	

* relative to mean
* preliminary value

courtesy of Japan ITSU National Contact

8 September 2002 -PTWC operations and warning system timeline

18:50 – Digital alarm triggered by seismic waves at CTAO, GUAM seismic stations.

18:56 – Initial location and magnitude determined. Observatory message issued with P-wave Moment Magnitude (Mw) 7.6, origin time 18:44 UTC, and epicenter 3.2S, 142.9E.

19:05 – Initiated contact with ATWC. Although both PTWC and ATWC felt Richter magnitude would eventually rise above the 7.5 threshold prompting issuance of a Watch/Warning, it was decided to issue a Tsunami Information Bulletin (TIB) at this time. Location refined with more data, and depth determined to be shallow.

19:08 – Issued Bulletin #1 (TIB) to both Pacific Region and Hawaii, with Ms 7.4, origin time 18:44 UTC, and epicenter 3.3S, 143.1E, near the north coast of Papua New Guinea (PNG).

19:10 – Personnel on telephone call-down list alerted, including Hawaii State Civil Defense, Hawaii County Civil Defense and ITIC Director.

19:20 – Attempted to contact Rabaul Volcano Observatory and Port Moresby Observatory by voice and Fax, but unable to get through. E-mails sent, but no replies received.

19:24 – Average Ms 7.6 using 25 station measurements. After coordinating with ATWC, PTWC upgraded tsunami message from TIB to Watch/Warning.

19:27 – Issued Bulletin #2 (Watch/Warning to Pacific Region and Tsunami Advisory Bulletin (TAB) to Hawaii), with Ms 7.6 and Mw 7.5. Location and origin time unchanged.

19:35 – Called ATWC. Based on tsunami travel time predictions, decision made to wait for until ~21:48 for the Kapingamarangi (KAPI, Kiribati) tide gauge data, which would have data for ~50 minutes after tsunami expected arrival. Although the Manus Island (Papua New Guinea) tide gauge closer to the source, gauge located in a sheltered bay and may have biased reading.

19:45 – ITIC sent email to Professor Hugh Davies of University of Papua New Guinea, providing Watch/Warning information and asking for early information on earthquake and tsunami.

20:01 – ITIC provided PTWC with PNG contact information, and sent Australian High Commission (AHC) in Port Moresby, PNG, e-mail with PTWC Bulletin; e-mail did not go through since address incorrect. Earlier, AHC had left a inquiry message on ITIC Director's office phone, which was not received because it was the weekend. PTWC telephoned AHC, who reported they were aware of the earthquake, but had no information on tsunami activity.

20:24 – ATWC contacted prior to sending Bulletin #3.

20:27 – Supplemental Watch/Warning messages issued to Pacific Region and TAB issued to Hawaii (Bulletin #3). Ms and Mw both increased to 7.7.

20:40 – Contacted Hawaii State Civil Defense (SCD) Emergency Operations Center Shift Leader. PTWC would need to wait for KAPI to see whether Pacific-wide tsunami generated. Tide gauge would not report until Hawaii technically in a Watch, but PTWC reiterated to SCD that it would not place Hawaii in a Watch unless tsunami confirmed. SCD Tsunami Program Manager contacted State Tsunami Advisor (also ITIC Director) to confirm that Pacific-wide tsunami not expected to impact Hawaii, and to find out -- continued on p. 12

WEWAK EARTHQUAKE AND TSUNAMI SURVEY

submitted by Hugh Davies, University of Papua New Guinea, PO Box 414, University NCD, PNG

In July 1998, two villages on the north coast of the Papua New Guinea mainland near Aitape (Fig. 1) were devestated by a catastrophic tsunami. The tsunami is thought to have been triggered by a submarine landslide following a strongly felt M_W 7.0 earthquake (Synolakis et al., 2002). Two other villages were damaged, and more than 1600 people were killed.

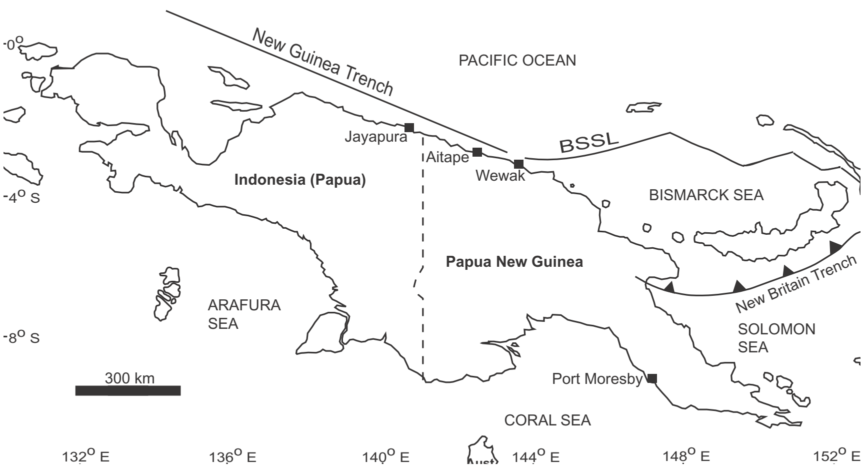


Fig. 1. Locality map shows the New Guinea Trench and the Bismarck Sea Seismic Lineament (BSSL)

Memories of this event were re-kindled in the pre-dawn hours of 9 September 2002 when a M_W 7.4 earthquake shook the coastal provincial headquarters of Wewak, 150 km from Aitape. People living near the coast and on the adjacent islands fled inland or to higher ground for fear of a tsunami.

As it happened, a moderate tsunami did develop, and reached Wewak about 15 minutes after the earthquake. On most of the coast, run-up was less than a meter, and there was little or no damage to property. However, at three locations where the tsunami was funneled into bays or between islands, run-up was greater and some houses were damaged or destroyed. No lives were lost and no injuries were caused by the tsunami.

Considerably more damage was caused by the earthquake, especially in areas underlain by unconsolidated sediment. People were injured and five lost their lives when houses collapsed or as they hurried to escape from shaking buildings.

When daylight came, local authorities moved quickly to establish a Provincial Disaster Center in what was otherwise the R.A. Seeto Betting Shop in Wewak, and to collect damage reports from the town and outlying areas. In Port Moresby, I received a phone call from an Australian aid agency officer, who had been notified of the earthquake by Geoscience Australia in Canberra. I flew to Wewak to assist with the initial assessment. My concern was to check for situations where people might still be at risk of injury, for example by movement of unstable ground, and to provide information to the public and the authorities (Fig. 2). A second visit followed a week later. Reports of these visits were posted on the Tsunami Bulletin Board (TBB).

The earthquake occurred at 18:44 hours UTC on 8 September (04:44 hours PNG local time on Monday 9 September), at 3.23°S, 142.87°E, depth 31 km. The USGS fast moment tensor solution is for strike-slip motion and northeast-southwest compression on near-vertical nodal planes oriented at either 350° or 080° (earthquake information is from the USGS website http://neic.usgs.gov/neis/FM/qmom.html).

The earthquake caused small extensional faults to develop in areas of unconsolidated sediment, notably at Kauk beach, and at Ubidnim, near the mouth of the Hawain River (see Figs. 3, 4). At both sites the faults were oriented near-parallel to the coast. In the lobby of the Windjammer Hotel in Wewak, floor tiles

Fig. 2 Author talks with the community on Tarawai, 9 September.

Wewak Earthquake Tsunami-*continued*

buckled and cracked as though responding to west-east or northwest-southeast compression. On the east and north coasts of Kairiru Island many landslides were triggered (Fig 5), and fissures with displacement of 10-30 cm opened on steep slopes as a result of incipient slope failure.

Liquefaction of unconsolidated subsurface sediments was common at localities from Kauk eastwards and was most pronounced at Ubidnim, where large blow-out holes developed (Fig. 6) and water and sand spouted 3-5 m into the air. At Ubidnim and other villages liquefied sediment moved upwards to fill open water wells.

The earthquake caused the collapse of brick school buildings at Hawain (see Fig. 3) but otherwise caused little damage to western-style buildings. In the villages about 10% of the houses, built of bush materials, collapsed completely and another 20% were damaged to some degree (Fig. 7), but the level of damage varied from place to place. Surprisingly, damage was not greater in the western villages that were closer to the epicenter. The worst hit, of the villages that I visited, were Ubidnim on the mainland, and Tarawai on the west coast of Tarawai Island.

Fig 3. Map of the Wewak area shows the earthquake epicentre, labeled 18:44, and localities mentioned in the text. Spot heights are in feet.

Fig. 4. Small normal faults and half-grabens developed in unconsolidated sediments beneath the beach at Kauk. Vertical displacement on this fault was 1.5 m, south block down.

In the coastal villages, and as far inland as Maprik, 30 km from the coast, corrugated iron water tanks failed. Plastic water tanks proved more durable (Fig 8). Road approaches at several bridges subsided by 10-20 cm, and a landslide temporarily blocked the coast highway at Hawain. In Wewak, water supply mains were severed in two places when a lightweight frame carrying the pipe across a river collapsed, and part of the buried concrete pipe failed due to movement of unconsolidated ground. At Wewak airport a 20-cm crack in the western taxi-way was caused by subsidence of unconsolidated sediment.

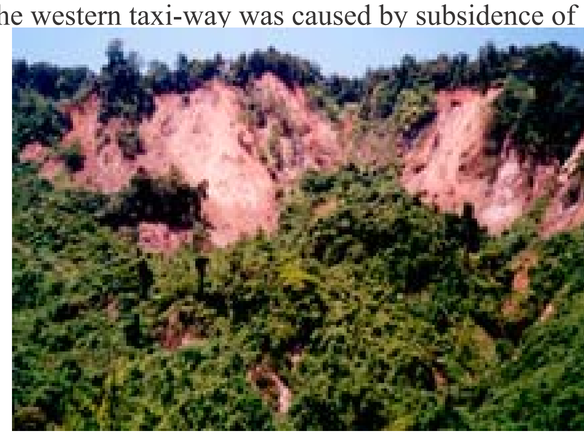


Fig 5. The photograph looks south at the eastern end of Kairiru Island, and shows some of the many landslides that developed on the northern slopes.

Noise and light effects

The earthquake was preceded by, and accompanied by, a roaring noise that approached Wewak from the west-northwest (information from Joe Borrish, Ubidnim), and a bright blue-green glow was seen in the sky above Kreer, immediately south of Wewak (information from night fishermen of Namba-2 Pasis).

Wewak Earthquake Tsunami-*continued*

Strong aftershocks occurred a week later and were a trigger for renewed concern in the community. The first was an M_W 6.3 event at 13:23 UTC on 16 September at 3.28°S, 142.62°E, depth 4 km, and the second an M_W 6.0 event at 11:20 UTC on 17 September, at 3.25°S, 142.79°E, depth 7 km.

Fig. 6 Liquefaction blow-out holes at Ubidnim, east of the mouth of the Hawain River.

Uplift

Three of the four outer islands, Tarawai, Walis, and Kairiru, were elevated by 30-40 cm. Similar uplift was observed at two locations on Mushu but was not obvious on all coasts; and there may have been some uplift of Yuo. The uplift caused the emergence, at mid-tide, of reefs and wave-cut platforms, and the setting of new strand lines on beaches. The most accurate record of uplift was on the jetty at St John's Seminary on the south coast of Kairiru Island where resident Graeme Lynch measured 35 cm of uplift in tide marks. Eye witnesses on Tarawai reported that the uplift happened some time after the earthquake, in two stages an hour apart.

As a result of the uplift, swamp lands on Tarawai, Walis and Mushu have been partly drained, and water in wells has dropped to a lower level. The swamplands are important as a source of sago, a staple food at times when garden produce is in short supply.

Fig. 7 View inside a collapsed house at Ubidnim.

The tsunami

A moderate tsunami followed about 15 minutes after the earthquake. Run up heights on open coast were generally less than 1 m, but reached 1.5 m at the westernmost point that was visited (Kauk, Fig. 3), and an estimated 3-4 m in west-facing bays on the islands, and on the mainland coast immediately east of Boiken (Fig. 3; Boiken information from Bishop Anthony Burgess ofm).

The higher run-up in the west-facing bays was a funneling effect. In both Victoria Bay and Mushu Bay, the larger of the west-facing bays on Mushu Island, observers saw the water circulate counter clockwise around the perimeter of the bay, and reach maximum height in the eastern extremity of each bay. Logs were washed ashore amongst the houses at Buruwan on Victoria Bay and 50 m of land was inundated (Fig. 9). Logs, coral and a moored dinghy (Fig. 10) were washed ashore in Mushu Bay. The reason for the higher run-up east of Boiken is less clear, but perhaps was due to the funneling of the tsunami between the coast and the islands.

Fig. 8 Rainwater collection tanks at Tarawai village. The roof supports and the corrugated iron tank failed.

Tsunami effects were observed as far east as Murik Lakes (Fig. 3; observations by Sir Peter Barter on 9 September), where water washed through the villages at ankle depth. The villages are on a low sand bar. In the west, a repeated rising and falling of the water level in the Aitape River of the order of 1 m above normal water level was observed at 6.45 to 7 am (report from Fr Tim Elliott ofm, on 9 September). In Wewak too, there was a fluctuation of the sea level at 6:45-7 am, the water draining out into the bay then returning passively to flood across the road, before subsiding to normal level. The drop in sea level was estimated to be 2 m, and the rise above normal sea level, 1.5-2 m (information from Roger Brinsden, engineer). The fluctuations at 6:45 am appear to have been a second and discrete tsunami event.

Wewak Earthquake Tsunami-*continued*

Volcanoes and landslides

There are hot springs in Victoria Bay, and the bay has a horseshoe shape and is fringed by outcrops of volcanic rocks. Following the strong aftershocks in the second week, rumors were rife that the Victoria Bay "volcano", or, alternatively, Kairiru's mountainous interior, were building up to an eruption. Check-mapping of Victoria Bay confirmed previous mapping which identified the volcanic rocks as remnants of an Oligocene volcanic arc. There were no Quaternary volcanic rocks and people could be advised that the likelihood of an eruption was minimal.

Fig. 9 At Buruwan in Victoria Bay, where run-up was 3-4 m, a driftwood log collided with this house.

Kairiru communities also expressed concern that the open fissures on the northern slopes of the island might be linked to a major zone of weakness, and that this might fail catastrophically. Inspection of some of the fissures showed that each was an isolated case of incipient slope failure and that, although landslides can be expected in future, they would not be on a scale greater than that to which the villagers are accustomed. At the time of writing a government geologist is in the field checking the stability of the landslides that were generated on 9 September.

Fig. 10 At Big Mushu, on the north shore of Mushu Bay, the tsunami swept a dinghy from its moorings and into the village. The grass in the foreground died because of sea water inundation.

Disaster relief

Relief is being provided in the form of tent flies for temporary shelter, water containers for carrying water, and some building supplies. Water tanks are needed urgently and there may be a need for some food relief in the islands in the future, where gardens may deteriorate and sago supply may decrease or even disappear because of the lower water table. There continues to be a need for a flow of information and advice from the authorities to reduce the level of fear and uncertainty in the community.

Geologic setting

Immediately north of the Wewak coast, the Pacific and Australian plates converge at a rate of 11 cma^{-1} on azimuth 070^{o}. Plate convergence is accommodated by strike-slip faulting on the Bismarck Sea Seismic Lineament, oblique subduction in the New Guinea Trench, and thrust and strike-slip faulting in the rocks of the upper plate (Fig. 1). However, there may also be some convergence in the lower plate: the earthquake of 9 September, if correctly located, was 22 km south of the New Guinea trench at a depth of 31 km, and thus was probably within the lower plate. The earthquake and aftershocks plot on a line that strikes about 080^{o}. Fast moment tensor solutions for all three earthquakes, from the USGS website, permit an interpretation that all three events occurred on an east-to-northeast-trending near-vertical left-lateral strike-slip fault.

Reference

Synolakis, C., Bardet, J-P., Borrero, J., Davies, H., Okal, E., Silver, E., Sweet, S., and Tappin, D., 2002, The slump origin of the 1998 Papua New Guinea Tsunami. Proceedings of the Royal Society London A 458:763-789.

Professor Hugh Davies can be contacted at hdavies@upng.ac.pg.

SUMMARY REPORT ON THE DEVELOPMENT OF NATIONAL TSUNAMI PLANS IN COLOMBIA AND ECUADOR

submitted by Emilio Lorca,
Servicio Hidrográfico y Oceanográfico de la Armada de Chile (SHOA)

In response to the ICG/ITSU XVIII meeting request from Colombia and Ecuador, Mr. Emilio Lorca from the Hydrographic and Oceanographic Service of the Chilean Navy visited Colombia and Ecuador from August 10-25, 2002, to assist them in developing tsunami mitigation plans and strategies for Tumaco, Colombia and Esmeraldas, Ecuador.

In Tumaco, Colombia, the Pacific Pollution Control Centre (CCCP) organized the Workshop, *Iniciativas para la Consolidación de un Sistema Local de Respuesta Efectivo en caso de Tsunami (First Steps to Consolidate an Effective Local Response System in case of Tsunami),* to discuss important issues with the local emergency committee. During the four days of the workshop, revisions of completed work were presented. Presentations were also given on the National Tsunami Warning System concept and Chile's experiences in operating its National Tsunami Warning System, and on the implementation of Local Tsunami Emergency Procedures. Tumaco, a set of three small low-lying barrier islands, is located off the southern Pacific coast close to the border with Ecuador, where the Nazca Plate subducts beneath the South American Plate. Four, large, 20th century earthquakes have generated tsunamis, with the most recent one in 1979 (magnitude 7.9) producing 2.5-m waves and claiming about 200 victims in surrounding villages. The northern coastline of Tumaco was locally inundated, shallowly flooding a number of houses. The highest wave rose about 0.8 m above the former high-tide position; tsunami damage would have been greater had the waves arrived at high tide. Around 80,000 people live on the islands, most of them concentrated on one of them. Two narrow bridges link the islands with the mainland. Because of the area's vulnerability, Colombia has identified an urgent need to take action to mitigate the effects of the next tsunami in the Bay of Tumaco.

Three round table discussions were held to identify, analyze, and evaluate (1) the most probable tsunami scenario, (2) possible evacuation procedures, and (3) warning modes. Secure areas, as well as evacuation routes, were discussed and defined. Finally, each of the local emergency agencies represented at the workshop were encouraged to develop their own specific plans following the general guidelines; these will then be discussed and integrated into the final comprehensive Tumaco Evacuation Plan.

At Guayaquil, Ecuador, the activities were centered at INOCAR (Instituto Oceanográfico de la Armada del Ecuador), which is part of the National Tsunami Warning System. Esmeraldas is a port with approximately 200,000 inhabitants, located on the northern coast of Ecuador, close to the border of Colombia, at the mouth of Esmeraldas River. The city has good infrastructure, such as broad and well-maintained streets and roads, and good phone communications. However, roughly 15% of the city's area is at low elevations, close to the river, and thus a tsunami could have a devastating impact to this urban area. Since tsunami simulations have not been done for Esmeraldas, which was struck by the same 1979 tsunami as Tumaco, Lorca recommended, as the first step, to work with the local emergency authorities to carry out tsunami modelling using existing software. The first three days at INOCAR were dedicated to outlining a comprehensive action plan, starting with the proper calculation of the tsunami risk at Esmeraldas and followed by the use of the numerical modelling to produce the tsunami inundation map. Ecuador was given a complete list of requirements needed to accomplish the mapping, along with a list of actions requiring the participation of the local emergency authorities if a local tsunami emergency team is to be formed.

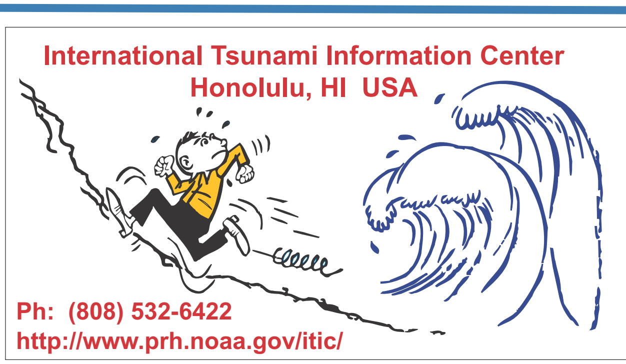
On the last two days, a road trip to Esmeraldas was organized to meet with Captain Daniel Donoso Velasquez of the Navy Port Authority. During the meeting, an account was given of what needs to be done during a tsunami emergency. It was recommended that the local Environment Impact Committee take the leadership role in local tsunami awareness activities, because Captain Donoso Velasquez heads the Committee and members include representatives from most of the local emergency agencies.

ITIC NEWS

Captain Fernando Mingram, PTWC Senior Electronics Technician Richard Nygard, Commander Nunez, and PTWC Geophysicist Dr. Stuart Weinstein outside PTWC in Ewa Beach, Hawaii.

During the week of October 7, 2002, Captain Fernando Mingram, Director of Servicio Hidrografico y Oceanografico de la Armada de Chile (SHOA) and Chile ITSU National Contact, and Commander Rodrigo Nunez, Head of SHOA's Sistema Nacional de Alerta de Maremotos and ITIC Associate Director, visited Honolulu and met with NOAA/National Weather Service Pacific Region Deputy Director Ed Young, ITIC, and Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) personnel.

At PTWC, Acting Geophysicist-in-Charge, Dr. Stuart Weinstein gave the visitors an overview of PTWC operations. Dr. Nunez also met with ITIC Director Dr. Laura Kong (both pictured to the right), who earlier in the week gave birth to her second daughter, Celia. They met to discuss the status of action items for the upcoming ITSU Officers meeting planned for early February, 2003, in Honolulu, Hawaii.



You may have noticed a slight uneven weight distribution when you went to open this issue of the **Tsunami Newsletter.** That's because we included a magnetic ITIC calling card with each mailed issue. Dialing the phone number will put you in contact with either Linda Sjogren or her voice mail. Please note that the URL printed on the magnet lacks a final slash and ideally would read as the one printed on the left, which has the final slash.

LOCAL TSUNAMI WARNING AND MITIGATION WORKSHOP SUMMARY

Petropavlovsk-Kamchatskiy, Russia, September 10 - 15, 2002

Professor Joanne Bourgeois during the workshop's field trip, explaining methodology employed in paleotsunami research.

submitted by
Dr. Mikhail Nosov
(Faculty of Physics, Moscow State University)
&
Dr. Boris Levin
(Russian Foundation for Basic Research, Moscow)

The International Workshop was organized jointly by the IUGG Tsunami Commission and the International Co-ordination Group for the Tsunami Warning System in the Pacific of the UNESCO. P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences (RAS) and the Kamchatka Seismological Department of Geophysical Service of the RAS led the Workshop as local organisers. The Workshop co-conveners were Prof. Joanne Bourgeois (U.S.A.) and Dr. Mikhail Nosov (Russia).

Destructive effects of many tsunamis are confined to areas within about one hour of the initial propagation time (that is, within a few hundred km of their source). These tsunamis are classified as local, as opposed to regional and Pacific-wide tsunamis whose destructive effects could be well outside (up to 10,000 km) of their area of origin. In all main Pacific tsunamigenic regions, the majority of tsunami-related casualties and property damage come from local tsunamis. The very short tsunami travel time increases the local tsunami hazard, and therefore presents an important challenge for the research community and decision-makers to identify ways for reducing losses of lives and property damage from the local tsunamis. Two international tsunami workshops have recently been held in Russia ("Tsunami Mitigation and Risk Assessment," Petropavlovsk-Kamchatskiy, 1996, and "Tsunami Risk Assessment Beyond 2000: Theory, Practice and Plans," Moscow, 2000). The success of these two meetings, as well as recommendations of the XVIII Session of UNESCO/IOC/ICG/ITSU, inspired us to convene another international tsunami workshop in Petropavlovsk-Kamchatskiy.

As one of the most active seismic- and tsunami-prone areas in the Pacific with a long history of recorded tsunamis, and complemented by interesting environmental features, Kamchatka was an appropriate place for international tsunami community members to convene to discuss local tsunami problems. Additionally, the workshop took place on the 50th anniversary of the 1952 Great Kamchatka Earthquake and Tsunami. The November 5, 1952, earthquake generated a catastrophic tsunami which killed more than 2000 people. The town of Severo-Kurilsk (Paramushir Island, south of Kamchatka) was completely destroyed. This catastrophic event served as a starting point for tsunami research in Russia, and many of the Russian tsunami community felt it their moral duty to convene a workshop in commemoration of the event.

Over 50 scientists (45 registered participants) from 12 countries (Bulgaria, Canada, France, French Polynesia, Indonesia, Italy, Japan, New Zealand, Republic of Korea, Russia, Turkey, U.S.A.) attended the Workshop. The Workshop programme and all submitted abstracts can be accessed online at http://oceanc47.phys.msu.su/.

The Workshop participants made 50 oral presentations on the following topics: 1952 Kamchatka Earthquake and Tsunami, Historical Catalogues and Databases, Seismo-tectonics of Tsunami, Numerical and Analytical Models of Local Tsunami Behaviour, Mitigation and Risk Assessment, Tsunami Geology and Paleotsunamis, Tsunami

WORKSHOP SUMMARY, *continued*

Measurement and Data Analysis, Hydroacoustic Methods in Tsunami Research. A separate student session, which Workshop participants unanimously recognized as being of high quality, was also convened to attract the participation of young scientists.

The Workshop also included field trips to Khalaktirka Beach and Kotelnoe Lake, where participants were exposed to paleotsunami methodology and practice by Professor Joanne Bourgeois (USA) and Dr. Tatiana Pinegina (Russia).

The Workshop organisers wish to acknowledge the Intergovernmental Oceanographic Commission (UNESCO), International Tsunami Information Center, Russian Foundation for Basic Research, Russian Academy of Sciences, and International Ocean Institute (Malta) for financial support of this meeting.

Field trip participants learning paleotsunami methodology.

Tsunami Generated by M6.5 Indian Ocean Earthquake

At least two people were killed and houses destroyed during a M6.5 earthquake off North Andaman Island on 13 September 2002 2238 UTC (13.013 N, 93.147E, USGS NEIC). The earthquake generated a small local tsunami that was observed near the generally uninhabited Ross and Smith Islands. The Associated Press and Times of India also reported that a wharf and some nearby houses were damaged, presumably from the tsunami, on Middle Andaman Island. The Harvard Centroid Moment Tensor solution showed thrust faulting at 29-km depth along a north-south strike parallel to existing tectonic lineaments in this region of the northeast Indian Ocean.

After an earthquake,
a tsunami may follow.
Move quickly to higher ground.

International Tsunami Information Center, Honolulu, HI USA
Ph: (808) 532-6422 http://www.prh.noaa.gov/itic/

Upcoming Conference

May 5-7 2003 (Monday-Wednesday), Fiji (Outrigger Reef)
Public Safety and Risk Management Conference. Sponsored by SOPAC (South Pacific Applied Geoscience Commission). The purpose of the conference is the promotion of disaster reduction policy/legislation development, research, training, scientific knowledge and technology transfer towards the reduction of community vulnerability from natural, environmental, technological and human induced disasters. For more information visit http://www.sopac.org.fj/Secretariat/Units/Dmu/Conference.html or contact: Vive Vuruyak; vive@sopac.org ; Tel: 679 338 1377.

Warning System Timeline *continued*

when PTWC expected to issue Final TAB stating no Watch/Warning would be issued. State Tsunami Advisor called PTWC, then called Tsunami Program Manager who relayed information to SCD Vice Director.

21:25 – Manus Island tide gauge data received. Small tsunami waves ~10-cm high with ~20-minute period observed. Tsunami arrival time at 20:12.

21:27 – Supplemental Watch/Warning messages issued to Pacific Region and TAB to Hawaii (Bulletin #4).

21:30 – ATWC contacted PTWC to discuss Manus Island tide gauge. PTWC to wait until the KAPI data received before issuing cancellation, because Manus time series very short and relatively noisy. ITIC received email from Professor Davies with reports on Wewak and Aitape, and observation of preliminary 1.5-m rise in sea level at Aitape.

21:50 – KAPI data received by PTWC. No tsunami waves observed.

21:51 – Called ATWC to confirm KAPI transmission and to confirm Watch/Warning cancellation.

21:53 – Watch/Warning cancellation message (Bulletin #5) issued to Pacific region and Final TAB issued to Hawaii.

22:00 – Hawaii call-down list executed to inform/confirm receipt of cancellation message. PTWC continued monitoring of tide gauges for 3.5 hours afterwards. No additional tsunami observed.

22:10 – PTWC received first reports of earthquake damage and tsunami in Wewak and Aitape.

23:06 – ITIC received additional PNG information from Professor Davies on Maprik, Suain, Sissano, and Wewak.

01:30 (9 September) – PTWC watchstanders stand down.

Located in Honolulu, the International Tsunami Information Center (ITIC) was established on November 12, 1965 by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). In 1968, IOC formed an International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU).

The 25 Member States are:
Australia, Canada, Chile, China, Colombia, Cook Islands, Costa Rica, Democratic People's Republic of Korea, Ecuador, Fiji, France, Guatemala, Indonesia, Japan, Mexico, New Zealand, Nicaragua, Peru, Philippines, Republic of Korea, Samoa, Singapore, Thailand, the Russian Federation and the United States of America.

http://www.shoa.cl/oceano/itic/frontpage.html

(Chile Site)

http://www.prh.noaa.gov/itic/

(USA Site)

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